PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-027785
(43)Date of publication of application : 31.01.1995

(51)Int.CI. G01P 15/12

(21)Application number : 05-168796
(22)Date of filing : 08.07.1993

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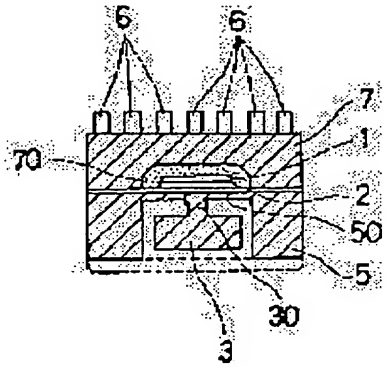
(54) ACCELERATION SENSOR

(57)Abstract:
PURPOSE: To axial obtain a low-cost sensor which can detect acceleration in three directions by a method wherein, when a weight is moved with reference to a substrate mounting plate, the substrate mounting plate and a single-crystal structure are deformed integrally and the electric resistance of a detection element is changed.
CONSTITUTION: A single-crystal substrate 1 is constituted of a square silicon chip, and it is provided with a detection element whose electric resistance is changed by mechanical deformation. A substrate mounting plate 2 is formed to be square shape which is a little larger than the substrate 1. A base stand 5 is formed to be a rectangular shape in a plane view, it is provided with a central thin sheetlike part 50, and a weight 3 is installed via a shaft part 30. Then, when an acceleration sensor constituted in this manner is attached to an object to be measured and an acceleration motion is caused, the weight 3 is moved with reference to the mounting plate 2 due to inertia, the mounting plate 2 and the substrate 1 are deformed integrally due to its movement, and the resistance value of the detection element is changed. A change in the resistance value of the detection element is converted into a voltage by an electronic device, and the acceleration of the object to be measured is read out as a voltage value.



LEGAL STATUS

[Date of request for examination] 12.04.2000
[Date of sending the examiner's decision of rejection] 11.09.2002
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]
[Claim 1] While having the sensing element (R) from which electric resistance changes with mechanical deformations on the straight line (Y) which intersects perpendicularly with a straight-line (X) top and this, said sensing element (R) centers on the intersection C of a straight line (X) and (Y). A same number individual every The single crystal substrate distributed and arranged (1), The substrate tie-down plate with which it has the coefficient of thermal expansion near the coefficient of thermal expansion of this single crystal substrate (1), and the field side, on the other hand, consisted of that metal plate used as the root face of a single crystal substrate (1) (2), The weight which fixed through the thin shank to a part for the another side surface part of said intersection (C) and a corresponding substrate tie-down plate (2) (3), The electronic instrument made to change resistance change of the above-mentioned sensing element (R) into electrical-potential-difference change is provided. The acceleration sensor characterized by a substrate tie-down plate (2) and a single crystal substrate (1) deforming in one, and making it the electric resistance of each sensing element (R) have changed when weight (3) moves to a substrate tie-down plate (2).
[Claim 2] While having the sensing element (R) from which electric resistance changes with mechanical deformations on the straight line (Y) which intersects perpendicularly with a straight-line (X) top and this, said sensing element (R) centers on the intersection C of a straight line (X) and (Y). A same number individual every The single crystal substrate distributed and arranged (1), The substrate tie-down plate with which it has the coefficient of thermal expansion near the coefficient of thermal expansion of this single crystal substrate (1), and the field side, on the other hand, consisted of that metal plate used as the root face of a single crystal substrate (1) (2), The pedestal with the central sheet metal-like section (50) which has fixed to the another side side side of said substrate tie-down plate (2) (5), The weight formed in said intersection (C) and the corresponding central sheet metal-like section (50) through the thin shaft (3), The electronic instrument made to change resistance change of the above-mentioned sensing element (R) into electrical-potential-difference change is provided. The acceleration sensor characterized by a substrate tie-down plate (2) and a single crystal substrate (1) deforming in one with said central sheet metal-like section (50), and making it the electric resistance of each sensing element (R) have changed when weight (3) moves to the central sheet metal-like section (50).
[Claim 3] The acceleration sensor according to claim 1 or 2 characterized by equipping a straight line (X) and (Y) with four sensing elements (R), respectively.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to an acceleration sensor.
[0002]
[Description of the Prior Art] There is a thing as shown in drawing 16 or drawing 17 as an acceleration sensor. Etching processing (Sign E shows the etching processing section) of the silicon substrate is carried out, and the two thin film sections are made to constitute, and he makes [this thin film part] a part for the weight section 91 and the both ends of a copper plate into the frame section 92 for said between [the thin film sections] part with a variant part 90, and is trying to surround said weight section 91 and variant part 90 with the silicon caps 93 and 93 by this sensor, as shown in this drawing.
[0003] The sensing element (usually called a piezoresistive element) from which electric resistance changes with mechanical deformations, respectively is prepared in the connection part with the frame section 92 in said variant part 90, a variant part 92 carries out elastic deformation with change of the relative-position relation between the frame section 92 and the weight section 91, and it is made for resistance of said sensing element to have changed. In addition, the electronic circuitry which changes resistance change of a sensing element into electrical-potential-difference change is made to provide in this acceleration sensor.
[0004] Therefore, when this acceleration sensor is attached in a device under test and accelerated motion is carried out, the relative-position relation between the weight section 91 and the frame section 92 will change with inertia, and the resistance of a sensing element will change, consequently the acceleration of a device under test can be read with an electrical-potential-difference value. However, in the above-mentioned acceleration sensor, there is a problem that only configuration top 1 shaft orientations (for example, the direction of X of the X-Y-Z directions) can be measured.
[0005] Moreover, by this sensor, in the process which forms a variant part 90, since a deep and exact etching technique is needed, it also has the problem of becoming cost quantity.
[0006]
[Problem(s) to be Solved by the Invention] So, let it be a technical problem to offer the acceleration sensor which can detect the acceleration of the triaxial direction and can be manufactured by low cost in this invention.
[0007]
[Means for Solving the Problem] While this acceleration sensor is equipped with the sensing element R from which electric resistance changes with mechanical deformations on the straight line Y which intersects perpendicularly with a straight-line X top and this, said sensing element R centers on the intersection C of straight-line X-Y. A same number individual every The single crystal substrate 1 distributed and arranged, The substrate tie-down plate 2 with which it has the coefficient of thermal expansion near the coefficient of thermal expansion of this single crystal substrate 1, and the field side, on the other hand, consisted of that metal plate used as the root face of the single crystal substrate 1, Said intersection C and the weight 3 which fixed through the thin shank to a part for the another side surface part of the corresponding substrate

tie-down plate 2, When the electronic instrument made to change resistance change of the above-mentioned sensing element R into electrical-potential-difference change is provided and weight 3 moves to the substrate tie-down plate 2, the substrate tie-down plate 2 and the single crystal substrate 1 deform in one, and it is made for the electric resistance of each sensing element R to have changed.

[0008] While this acceleration sensor is equipped with the sensing element R from which electric resistance changes with mechanical deformations on the straight line Y which intersects perpendicularly with a straight-line X top and this, said sensing element R centers on the intersection C of straight-line X and Y. A same number individual every Moreover, the single crystal substrate 1 distributed and arranged, The substrate tie-down plate 2 with which it has the coefficient of thermal expansion near the coefficient of thermal expansion of this single crystal substrate 1, and the field side, on the other hand, consisted of that metal plate used as the root face of the single crystal substrate 1, The pedestal 5 with the central sheet metal-like section 50 which has fixed to the another side side side of said substrate tie-down plate 2, Said intersection C and the weight 3 formed in the corresponding central sheet metal-like section 50 through the thin shaft, When the electronic instrument made to change resistance change of the above-mentioned sensing element R into electrical-potential-difference change is provided and weight 3 moves to the central sheet metal-like section 50, the substrate tie-down plate 2 and the single crystal substrate 1 deform in one with said central sheet metal-like section 50, and it is made for the electric resistance of each sensing element R to have changed.

[0009]

[Function] This invention acts as follows. When the acceleration sensor of this invention is attached in a device under test and accelerated motion is carried out, weight 3 moves to the substrate tie-down plate 2 according to inertia, the substrate tie-down plate 2 and the single crystal substrate 1 deform in one in connection with this, and the resistance of a sensing element R changes. Resistance change of this sensing element R will be changed into an electrical potential difference by the electronic instrument, and the acceleration of a device under test can read it as an electrical-potential-difference value.

[0010] Here, since it has the sensing element R from which electric resistance changes with mechanical deformations to the above-mentioned single crystal substrate 1 on the straight line Y which intersects perpendicularly with a straight-line X top and this, and said sensing element R is distributed a same number individual every centering on the intersection C of straight-line X-Y and it arranges, the acceleration of the triaxial direction of X-Y-Z can detect. Moreover, by this sensor, since an advanced etching technique which was indicated in the column of a Prior art becomes unnecessary, it can be manufactured by low cost.

[0011] In addition, since coefficient of thermal expansion of the above-mentioned substrate tie-down plate 2 is made into the coefficient of thermal expansion near the single crystal substrate 1, although a variant part consists of two structures, a big resistance change of the sensing element R by change of ambient temperature does not take place like the sensor indicated in the column of a Prior art. Moreover, when weight 3 moves to the central sheet metal-like section 50 of the pedestal 5 installed by the substrate tie-down plate 2 to the central sheet metal-like section 50 in the case of what has weight 3, the substrate tie-down plate 2 and the single crystal substrate 1 deform in one with the central sheet metal-like section 50.

[0012]

[Example] Hereafter, it explains according to the drawing in which the configuration of this invention was shown as an example. The acceleration sensor of this example is what surrounds the sensor section with a pedestal 5 and cap 7, as shown in drawing 1 . Fundamentally The substrate tie-down plate 2 which fixed on the top face of the central sheet metal-like section 50 of the pedestal 5 with the central sheet metal-like section 50, and this pedestal 5 as shown in drawing 2 or drawing 6 , The lead 6 of a large number arranged in the perimeter of said substrate tie-down plate 2, the single crystal substrate 1 which fixed on said substrate tie-down plate 2, said single crystal substrate 1, and lead 6 part on a pedestal 5 consist of wrap caps 7.

[0013] As shown in drawing 3 or drawing 4 , the silicon chip of a square configuration constitutes the single crystal substrate 1, and it is equipped with the sensing element R from which electric

resistance changes with mechanical deformations on the straight line Y which intersects perpendicularly with a straight-line X top and this. In addition, it has carried out electrical installation (wire bonding) of these and the lead 6 with Wire W while distributing every two of said sensing element R and arranging it centering on the intersection C of straight-line X-Y, as shown in this drawing or drawing 6 .

[0014] The substrate tie-down plate 2 consists of covar, 42 alloys, etc., and as shown in drawing 6 , it is formed in the shape of [than the single crystal substrate 1 / somewhat larger] a square. The pedestal 5 is formed in the shape of a plane view rectangle, as shown in drawing 1 or drawing 2 , and it is arranging weight 3 in the intersection C in this central sheet metal-like section 50, and a corresponding part through a shank 30 while it has the above-mentioned central sheet metal-like section 50. In addition, the so-called mold resin for IC constitutes the pedestal 5 whole containing weight 3 from this example.

[0015] As shown in drawing 1 or drawing 6 , from the substrate tie-down plate 2, only fixed distance is detached, and lead 6 arranges inner one end, and has bent the outer edge side. The cap 7 is formed in the shape of a plane view rectangle, and is constituted by synthetic resin homogeneous as a pedestal 5. Moreover, an electronic instrument has the bridge circuit 4 which connects and changes, as the above-mentioned sensing element R is shown in drawing 5 , and it enables it to have read in resistance change of said sensing element R the acceleration which acts on this sensor as an electrical signal while it changes the resistance of each sensing element R into an electrical-potential-difference value.

[0016] Since this sensor is considered as the above-mentioned configuration, as shown below, it can perform measurement of acceleration.

** Weight 3 moves [as opposed to / when this acceleration sensor is attached in the acceleration device under test of X component and the left-hand side of the direction of X is made to carry out accelerated motion, as it is shown in drawing 7 / a pedestal 5] to right-hand side according to inertia, and deform in connection with this in [the substrate tie-down plate 2 and the single crystal substrate 1 / as the central sheet metal / of a pedestal 5 /-like section 50] one. And the electric resistance of a sensing element R changes in connection with this (resistance increases the sensing elements Rx1 and Rx3 on which distortion of the direction of tension acts, and, as for the sensing element Rx2 on which distortion of the compression direction acts, and Rx4, resistance decreases).

[0017] In addition, when the right-hand side of the direction of X is made to carry out accelerated motion of the device under test, the resistance of sensing elements Rx2 and Rx4 increases, and a sensing element Rx1 and the resistance of Rx3 decrease.

** The resistance of a sensing element R changes in the mode as the above-mentioned ** with the same acceleration of Y component of the acceleration device under test of Y component.

** Weight 3 moves [as opposed to / when this acceleration sensor is attached in the acceleration device under test of Z component and accelerated motion is carried out to the Z direction bottom, as it is shown in drawing 8 / a pedestal 5] to the bottom according to inertia, and deform into convex in connection with this in [the substrate tie-down plate 2 and the single crystal substrate 1 / as the central sheet metal / of a pedestal 5 /-like section 50] one. Therefore, sensing elements Rx1 and Rx3 The resistance of Rx2 and Rx4 increases. In addition, when accelerated motion of the device under test is carried out to the Z direction bottom, they are sensing elements Rx1 and Rx3. The resistance of Rx2 and Rx4 decreases.

[0018] Thus, the resistance of a sensing element R is detected as electrical-potential-difference change by the electronic instrument which includes the bridge circuit 4 which changes with migration directions of a sensor, respectively, and which described this resistance change above although it changes, and it is indicated by vision as acceleration of each X-Y-Z direction. Here, the manufacture approach of the sensor of this example is explained below.

The leadframe LF which consists of the connection S which connects said substrate tie-down plate 2 and both lead 6 with two or more substrate tie-down plates 2 with which the single crystal substrate 1 as shows the 1st ** first to drawing 9 from the metal plates (covar, 42 alloys, etc.) near the coefficient of thermal expansion of the single crystal substrate 1 is stretched, and the lead 6 of a large number arranged in order to surround these, respectively is manufactured.

The 2nd process, next the single crystal substrate 1 which made the sensing element R arrange like the above are stretched to each substrate tie-down plate 2, as shown in drawing 10 or drawing 11 , and between lead 6 is electrically connected with a sensing element with Wire W proper.
As shown in the 3rd process, then drawing 12 , the surface-protection material 70 is applied and cap 7 is cast by the mold resin for IC that the prepuce of this surface-protection material 70 grade should be carried out (molding).
As shown in the 4th process and drawing 13 , a pedestal 5 is cast by the mold resin for IC (molding).
[0019] In addition, it may be made to perform molding in this process to it of the 3rd process, and coincidence.
it is shown in drawing 14 after that [5th process] — as — Leadframe LF to the connection S -- separation (a two-dot chain line n is cut) — carrying out — the outer edge part of lead 6 — bending (foaming being carried out) — an acceleration sensor is completed.
[0020] In addition, the tubed pedestal 5 without the central sheet metal-like section 50 may be made to constitute, the metal weight 3 may be welded to the inferior-surface-of-tongue parts of the intersection C of straight-line X-Y, and the corresponding substrate tie-down plate 2 through a shaft 30, and, thereby, a sensor may be made to constitute, as it changes to the above-mentioned example and is shown in drawing 15 . Moreover, it changes to the above-mentioned example and you may make it form a pedestal 5 in the shape of a cap, as shown in drawing 15 .
[0021]
[Effect of the Invention] Since this invention is the above configurations, it has the following effectiveness. The acceleration sensor which can detect the acceleration of the triaxial direction and can be manufactured by low cost from the contents indicated from the column of an operation has been offered.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The appearance perspective view of the acceleration sensor of the example of this invention.
[Drawing 2] The sectional view of said acceleration sensor.
[Drawing 3] The top view showing arrangement of the sensing element which the single crystal substrate of said acceleration sensor was made to possess.
[Drawing 4] The sectional view of the important section of said acceleration sensor.
[Drawing 5] Drawing of a bridge circuit which changes into an electrical-potential-difference value the resistance of the sensing element which said acceleration sensor was made to possess.
[Drawing 6] The top view showing relation, such as a wire, with the substrate tie-down plate which said acceleration sensor was made to possess, a single crystal substrate, and a lead.
[Drawing 7] The sectional view showing deformation conditions, such as a single crystal substrate at the time of acting the acceleration of the direction of X on said acceleration sensor.

[Drawing 8] The sectional view showing deformation conditions, such as a single crystal substrate at the time of acting the acceleration of a Z direction on said acceleration sensor.
[Drawing 9] The top view of the leadframe used for manufacture of said acceleration sensor.
[Drawing 10] The top view showing the condition of having carried out wire bonding of between leads to the single crystal substrate while fixing the single crystal substrate on the top face of the substrate tie-down plate of said leadframe.
[Drawing 11] The side elevation showing the condition of having fixed the single crystal substrate on the top face of the substrate tie-down plate of said leadframe.
[Drawing 12] The sectional view showing the condition of having prepared in the leadframe the cap which applies surface-protection material to said single crystal substrate etc., and carries out the prepuce of these.
[Drawing 13] The sectional view showing the condition of having prepared the pedestal in said leadframe.
[Drawing 14] The top view having shown the isolation location of the connection in said leadframe.
[Drawing 15] The sectional view of the acceleration sensor of other examples of this invention.
[Drawing 16] The sectional view of the conventional acceleration sensor.
[Drawing 17] The important section perspective view of the conventional acceleration sensor.
[Description of Notations]
R Sensing element
X Straight line
Y Straight line
C Intersection
1 Single Crystal Substrate
2 Substrate Tie-down Plate
3 Weight

4 Bridge Circuit
5 Pedestal
50 Central Sheet Metal-like Section

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平７－２７７８５

(43)公開日　平成７年（１９９５）１月３１日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ	技術表示箇所
G01P 15/12				

審査請求　未請求　請求項の数３　ＯＬ　（全６頁）

(21)出願番号　特願平５－１６８７９６

(22)出願日　平成５年（１９９３）７月８日

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(54)【発明の名称】加速度センサー

(57)【要約】

【目的】　三軸方向の加速度が検出でき且つ低コストで製造できる加速度センサーを提供すること。

【構成】　機械的変形により電気抵抗が変化する検出素子Ｒを直線Ｘ上及びこれと直交する直線Ｙ上に備えると共に前記検出素子Ｒが直線Ｘ・Ｙの交点Ｃを中心として同数個づつ振り分けて配置してある単結晶基板１と、この単結晶基板１の熱膨張率に近い熱膨張率を有し、その一方面側が単結晶基板１の固着面となる金属板で構成された基板取付板２と、前記交点Ｃと対応する基板取付板２の他方面部分に細い軸部を介して固着された重り３と、上記検出素子Ｒの抵抗変化を電圧変化に変換せしめる電子装置とを具備し、基板取付板２に対して重り３が移動したときには基板取付板２と単結晶基板１とが一体的に変形して各検出素子Ｒの電気抵抗が変化するようにしてある。

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【特許請求の範囲】

【請求項１】　機械的変形により電気抵抗が変化する検出素子（Ｒ）を直線（Ｘ）上及びこれと直交する直線（Ｙ）上に備えると共に前記検出素子（Ｒ）が直線（Ｘ）（Ｙ）の交点Ｃを中心として同数個づつ振り分けて配置してある単結晶基板（１）と、この単結晶基板（１）の熱膨張率に近い熱膨張率を有し、その一方面側が単結晶基板（１）の固着面となる金属板で構成された基板取付板（２）と、前記交点（Ｃ）と対応する基板取付板（２）の他方面部分に細い軸部を介して固着された重り（３）と、上記検出素子（Ｒ）の抵抗変化を電圧変化に変換せしめる電子装置とを具備し、基板取付板（２）に対して重り（３）が移動したときには基板取付板（２）と単結晶基板（１）とが一体的に変形して各検出素子（Ｒ）の電気抵抗が変化するようにしてあることを特徴とする加速度センサー。

【請求項２】　機械的変形により電気抵抗が変化する検出素子（Ｒ）を直線（Ｘ）上及びこれと直交する直線（Ｙ）上に備えると共に前記検出素子（Ｒ）が直線（Ｘ）（Ｙ）の交点Ｃを中心として同数個づつ振り分けて配置してある単結晶基板（１）と、この単結晶基板（１）の熱膨張率に近い熱膨張率を有し、その一方面側が単結晶基板（１）の固着面となる金属板で構成された基板取付板（２）と、前記基板取付板（２）の他方面側に固着されている、中央薄板状部（５０）を有した基台（５）と、前記交点（Ｃ）と対応する中央薄板状部（５０）に細い軸を介して設けられている重り（３）と、上記検出素子（Ｒ）の抵抗変化を電圧変化に変換せしめる電子装置とを具備し、中央薄板状部（５０）に対して重り（３）が移動したときには基板取付板（２）と単結晶基板（１）が前記中央薄板状部（５０）と一体的に変形して各検出素子（Ｒ）の電気抵抗が変化するようにしてあることを特徴とする加速度センサー。

【請求項３】　直線（Ｘ）（Ｙ）にそれぞれ四個の検出素子（Ｒ）を備えていることを特徴とする請求項１又は２記載の加速度センサー。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は、加速度センサーに関するものである。

【０００２】

【従来の技術】加速度センサーとしては図１６や図１７に示すようなものがある。このセンサーでは、同図に示すように、シリコン基板をエッチング処理（エッチング処理部を符号Ｅで示す）して二つの薄膜部を構成させ、この薄膜部分を変形部９０と、前記薄膜部相互間部分を重り部９１と、銅板の両端部分をフレーム部９２とし、前記重り部９１や変形部９０をシリコンキャップ９３，９３で包囲するようにしている。

【０００３】前記変形部９０におけるフレーム部９２との接続部分には、それぞれ機械的変形により電気抵抗が変化する検出素子（通常、ピエゾ抵抗素子と呼ばれる）を設けてあり、フレーム部９２と重り部９１との相対位置関係の変化に伴って変形部９２が弾性変形し、前記検出素子の抵抗が変化するようにしてある。尚、この加速度センサーでは、検出素子の抵抗変化を電圧変化に変換する電子回路を具備させてある。

【０００４】したがって、被測定物にこの加速度センサーを取付けて加速度運動をさせた場合、慣性により重り部９１とフレーム部９２との相対位置関係が変化して検出素子の抵抗値が変化し、その結果、被測定物の加速度を電圧値で読み取れることとなる。しかしながら、上記加速度センサーでは、その構成上一軸方向（例えば、Ｘ－Ｙ－Ｚ方向のうちのＸ方向）しか測定できないという問題がある。

【０００５】又、このセンサーでは、変形部９０を形成する工程において、深く且つ正確なエッチング技術を必要とするから、コスト高となってしまうという問題も有している。

【０００６】

【発明が解決しようとする課題】そこで、この発明では、三軸方向の加速度が検出でき且つ低コストで製造できる加速度センサーを提供することを課題とする。

【０００７】

【課題を解決するための手段】この加速度センサーは、機械的変形により電気抵抗が変化する検出素子Ｒを直線Ｘ上及びこれと直交する直線Ｙ上に備えると共に前記検出素子Ｒが直線Ｘ・Ｙの交点Ｃを中心として同数個づつ振り分けて配置してある単結晶基板１と、この単結晶基板１の熱膨張率に近い熱膨張率を有し、その一方面側が単結晶基板１の固着面となる金属板で構成された基板取付板２と、前記交点Ｃと対応する基板取付板２の他方面部分に細い軸部を介して固着された重り３と、上記検出素子Ｒの抵抗変化を電圧変化に変換せしめる電子装置とを具備し、基板取付板２に対して重り３が移動したときには基板取付板２と単結晶基板１とが一体的に変形して各検出素子Ｒの電気抵抗が変化するようにしてある。

【０００８】また、この加速度センサーは、機械的変形により電気抵抗が変化する検出素子Ｒを直線Ｘ上及びこれと直交する直線Ｙ上に備えると共に前記検出素子Ｒが直線Ｘ・Ｙの交点Ｃを中心として同数個づつ振り分けて配置してある単結晶基板１と、この単結晶基板１の熱膨張率に近い熱膨張率を有し、その一方面側が単結晶基板１の固着面となる金属板で構成された基板取付板２と、前記基板取付板２の他方面側に固着されている、中央薄板状部５０を有した基台５と、前記交点Ｃと対応する中央薄板状部５０に細い軸を介して設けられている重り３と、上記検出素子Ｒの抵抗変化を電圧変化に変換せしめる電子装置とを具備し、中央薄板状部５０に対して重り３が移動したときには基板取付板２と単結晶基板１が前

記中央薄板状部５０と一体的に変形して各検出素子Ｒの電気抵抗が変化するようにしてある。

【０００９】

【作用】この発明は次のように作用する。被測定物にこの発明の加速度センサーを取付けて加速度運動をさせた場合、慣性により重り３が基板取付板２に対して移動し、これに伴って基板取付板２と単結晶基板１とが一体的に変形して検出素子Ｒの抵抗値が変化する。この検出素子Ｒの抵抗変化は電子装置により電圧に変換され、被測定物の加速度が電圧値として読み取れることとなる。

【００１０】ここで、上記単結晶基板１には、機械的変形により電気抵抗が変化する検出素子Ｒを直線Ｘ上及びこれと直交する直線Ｙ上に備えてあり、前記検出素子Ｒは直線Ｘ・Ｙの交点Ｃを中心として同数個づつ振り分けて配置してあることから、Ｘ－Ｙ－Ｚの三軸方向の加速度が検出し得る。また、このセンサーでは、従来の技術の欄に記載したような高度なエッチング技術は不要となるから低コストで製造できる。

【００１１】尚、上記基板取付板２の熱膨張率は単結晶基板１に近い熱膨張率としてあるから、変形部が二つの構成物から成るものであるにもかかわらず、従来の技術の欄に記載したセンサーと同様に雰囲気温度の変化による検出素子Ｒの大きな抵抗変化は起こらない。また、基板取付板２に添着された基台５の中央薄板状部５０に重り３を有するものの場合、中央薄板状部５０に対して重り３が移動したときには基板取付板２及び単結晶基板１が中央薄板状部５０と一体的に変形する。

【００１２】

【実施例】以下、この発明の構成を実施例として示した図面に従って説明する。この実施例の加速度センサーは、図１に示すように、基台５とキャップ７によりセンサー部を包囲するものであり、基本的には、図２や図６に示すように、中央薄板状部５０を有した基台５と、この基台５の中央薄板状部５０の上面に固着された基板取付板２と、前記基板取付板２の周囲に配設された多数のリード６と、前記基板取付板２上に固着された単結晶基板１と、前記単結晶基板１及び基台５上のリード６部分を覆うキャップ７とから構成されている。

【００１３】単結晶基板１は、図３や図４に示すように、正方形状のシリコンチップにより構成してあり、機械的変形により電気抵抗が変化する検出素子Ｒを直線Ｘ上及びこれと直交する直線Ｙ上に備えている。尚、前記検出素子Ｒは、同図や図６に示す如く直線Ｘ・Ｙの交点Ｃを中心として二個づつ振り分けて配置させてあると共に、これらとリード６とをワイヤーＷで電気的接続（ワイヤーボンディング）してある。

【００１４】基板取付板２は、コバールや４２アロイ等から構成されており、図６に示すように単結晶基板１よりも少し大きい正方形状に形成されている。基台５は、図１や図２に示すように平面視長方形状に形成されており、上記した中央薄板状部５０を有すると共にこの中央薄板状部５０における交点Ｃと対応する部分に軸部３０を介して重り３を配設している。尚、この実施例では、重り３を含む基台５全体を所謂ＩＣ用モールド樹脂で構成している。

【００１５】リード６は、図１や図６に示すように、内端側を基板取付板２から一定距離だけ離して配置し、外端側を折り曲げてある。キャップ７は、平面視長方形状に形成されており基台５と同質の合成樹脂により構成されている。また、電子装置は、上記検出素子Ｒを図５に示す如く接続して成るブリッジ回路４を有するもので、各検出素子Ｒの抵抗値を電圧値に変換すると共に前記検出素子Ｒの抵抗変化からこのセンサーに作用する加速度を電気信号として読み取れるようにしてある。

【００１６】このセンサーは上記構成としてあるから以下に示す如く加速度の測定ができる。

①Ｘ成分の加速度

被測定物にこの加速度センサーを取付けてＸ方向の左側に加速度運動をさせた場合、図７に示すように慣性により重り３が基台５に対して右側に移動し、これに伴って基板取付板２及び単結晶基板１が基台５の中央薄板状部５０と一体的に変形する。そして、これに伴い検出素子Ｒの電気抵抗が変化（引張り方向の歪みが作用する検出素子R_{11}，R_{12}は抵抗値が増加し、圧縮方向の歪みが作用する検出素子R_{21}，R_{22}は抵抗値が減少する）する。

【００１７】尚、被測定物をＸ方向の右側に加速度運動させた場合、検出素子R_{11}，R_{12}の抵抗値が増加し、検出素子R_{21}，R_{22}の抵抗値が減少する。

②Ｙ成分の加速度

被測定物のＹ成分の加速度は上記①と同様の態様で検出素子Ｒの抵抗値が変化する。

③Ｚ成分の加速度

被測定物にこの加速度センサーを取付けてＺ方向の下側に加速度運動をさせた場合、図８に示すように慣性により重り３が基台５に対して上側に移動し、これに伴って基板取付板２及び単結晶基板１が基台５の中央薄板状部５０と一体的に凸状に変形する。したがって検出素子R_{11}，R_{12}，R_{21}，R_{22}の抵抗値は増加する。尚、被測定物をＺ方向の上側に加速度運動させた場合、検出素子R_{11}，R_{12}，R_{21}，R_{22}の抵抗値は減少する。

【００１８】このように、検出素子Ｒの抵抗値はセンサーの移動方向によりそれぞれ異なる変化するが、この抵抗変化は上記したブリッジ回路４を含む電子装置により電圧変化として検出され、各Ｘ－Ｙ－Ｚ方向の加速度として視覚表示される。ここで、以下に、この実施例のセンサーの製造方法について説明する。

第１工程

先ず、単結晶基板１の熱膨張率に近い金属板（コバール，４２アロイ等）から、図９に示すような、単結晶基板１が張設される複数の基板取付板２と、これらをそれ

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ぞれ取り囲むべく配列された多数のリード６と、前記基板取付板２とリード６相互を繋ぐ接続部Ｓから成るリードフレームＬＦを製作する。

第２工程

次に、検出素子Ｒを上記の如く配列させた単結晶基板１を、図１０や図１１に示すように、各基板取付板２に張設し、検出素子とリード６相互間を適正にワイヤーＷで電気的に接続する。

第３工程

続いて、図１２に示すように、表面保護材７０を塗布し、この表面保護材７０等を包皮すべくＩＣ用モールド樹脂でキャップ７を成型（モールディング）する。

第４工程

そして、図１３に示すように、ＩＣ用モールド樹脂で基台５を成型（モールディング）する。

【００１９】尚、この工程におけるモールディングは第３工程のそれと同時に行うようにしてもよい。

第５工程

その後、図１４に示すように、リードフレームＬＦから接続部Ｓを分離（二点鎖線ｎを切断）し、リード６の外端部分を折曲げる（フォーミングする）と、加速度センサーは完成する。

【００２０】尚、上記実施例にかえて、図１５に示すように、中央薄板状部５０が無い箇状の基台５を構成させ、直線Ｘ・Ｙの交点Ｃと対応する基板取付板２の下面部分に金属製の重り３を軸３０を介して溶接し、これによりセンサーを構成させてもよい。又、上記実施例にかえて、図１５に示すように基台５をキャップ状に形成するようにしてもよい。

【００２１】

【発明の効果】この発明は上記の様な構成であるから次の効果を有する。作用の欄から記載した内容から、三軸方向の加速度が検出でき且つ低コストで製造できる加速度センサーを提供できた。

【図面の簡単な説明】

【図１】この発明の実施例の加速度センサーの外観斜視図。

【図２】前記加速度センサーの断面図。

【図３】前記加速度センサーの単結晶基板に具備させた検出素子の配置を示す平面図。

【図４】前記加速度センサーの要部の断面図。

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【図５】前記加速度センサーに具備させた検出素子の抵抗値を電圧値に変換するブリッジ回路の図。

【図６】前記加速度センサーに具備させた基板取付板と、単結晶基板と、リードと、ワイヤー等の関係を示す平面図。

【図７】前記加速度センサーにＸ方向の加速度が作用した場合における、単結晶基板等の変形状態を示す断面図。

【図８】前記加速度センサーにＺ方向の加速度が作用した場合における、単結晶基板等の変形状態を示す断面図。

【図９】前記加速度センサーの製作に使用されるリードフレームの平面図。

【図１０】前記リードフレームの基板取付板の上面に単結晶基板を固着すると共に単結晶基板とリード相互間をワイヤーボンディングした状態を示す平面図。

【図１１】前記リードフレームの基板取付板の上面に単結晶基板を固着した状態を示す側面図。

【図１２】前記単結晶基板等に表面保護材を塗布し、これらを包皮するキャップをリードフレームに設けた状態を示す断面図。

【図１３】前記リードフレームに基台を設けた状態を示す断面図。

【図１４】前記リードフレームにおける接続部の切離し位置を示した平面図。

【図１５】この発明の他の実施例の加速度センサーの断面図。

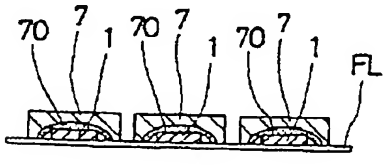
【図１６】従来の加速度センサーの断面図。

【図１７】従来の加速度センサーの要部斜視図。

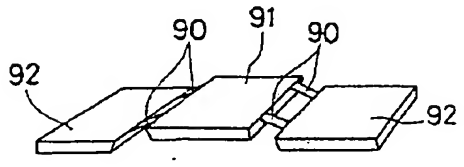
【符号の説明】

Ｒ　検出素子
Ｘ　直線
Ｙ　直線
Ｃ　交点
１　単結晶基板
２　基板取付板
３　重り
４　ブリッジ回路
５　基台
５０　中央薄板状部

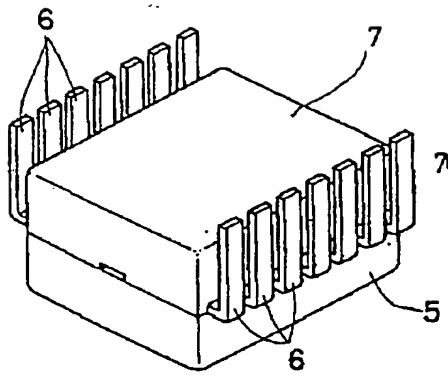
【図１２】



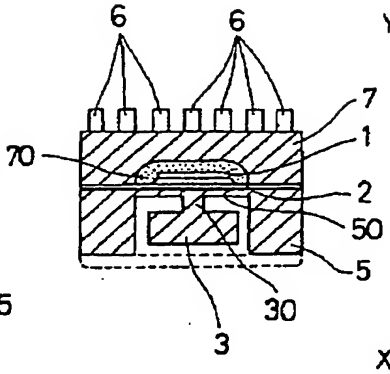
【図１７】



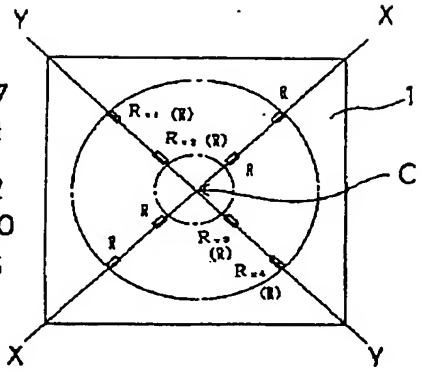
【図１】



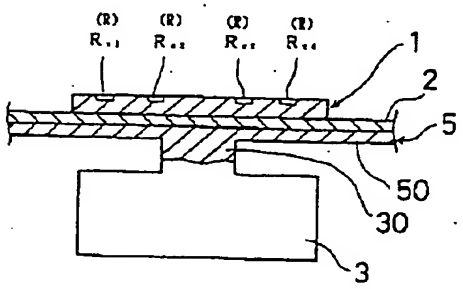
【図２】



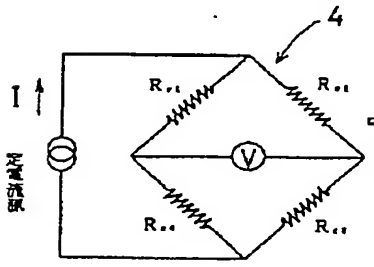
【図３】



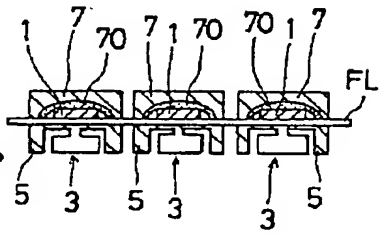
【図４】



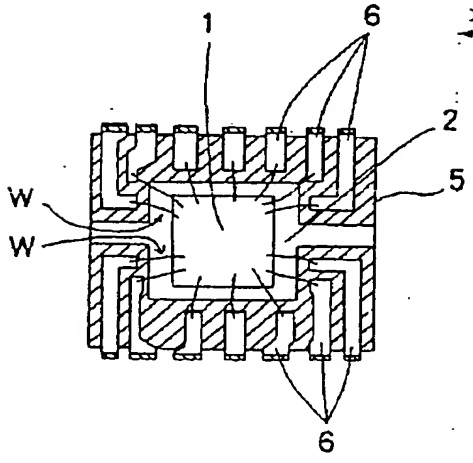
【図５】



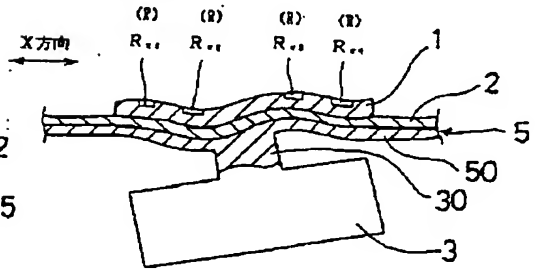
【図１３】



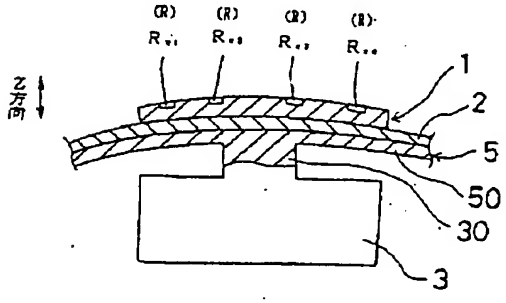
【図６】



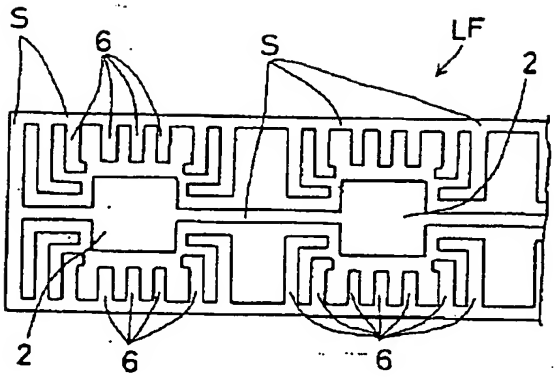
【図７】



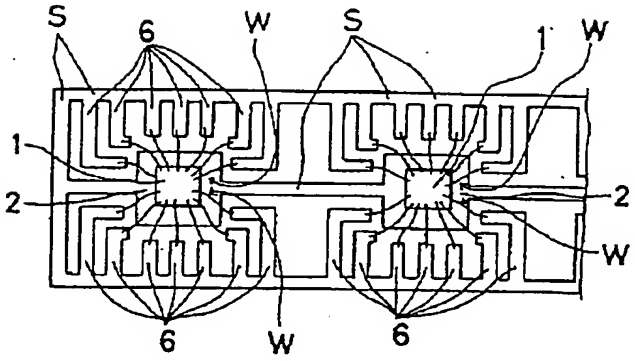
【図８】



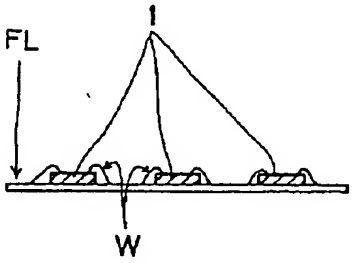
【図９】



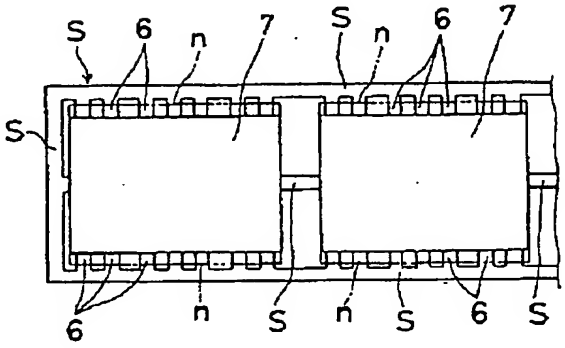
【図１０】



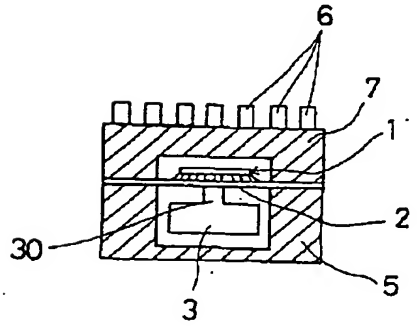
【図１１】



【図１４】



【図１５】



【図１６】